

STUDIES ON *LAPHYGMA EXIGUA* HB. AND ITS NATURAL ENEMIES.

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INTRODUCTION.

The caterpillars of *Laphygma exigua* Hb., belong to the well-known family of cutworms (*Noctuidae*) which are known to devastate growing crops. According to Lefroy¹ this insect enjoys a world-wide distribution, being found in Europe, South Africa, North and South America, Oriental regions, and Honolulu. In India, it is distributed throughout the hills as well as the plains. Fletcher² has recorded a wide range of host plants such as lucerne, indigo, onions, chillies, gingelly, cowpea, brinjal, radish and Amaranthus in South India. Subsequently, Ramachandra Rao³ has recorded it as a serious pest on Daincha (*Sesbania aculeata*), turmeric, maize and castor; he⁴ has also noted it as a pest on ragi (*Eleusine coracana*) nurseries, and ganja plants (*Cannabis sativa*). It has also been further noted on coriander, sorghum and agathi (*Sesbania grandiflora*). More recently it was noted on cotton by the authors. In North India, Fletcher⁵ has recorded it on a large variety of economic plants. Recently, the pest has come to attract a good deal of attention from the India Leaf Tobacco Development Company whose extensive tobacco nurseries at Chirala (Guntur District) were invariably subjected to severe damage every year in the early stages, by the caterpillars. Up till now there has been no record of the above caterpillars being noted as a pest on tobacco nurseries in South India. This is the first record of its kind. At the request of the Company, preliminary investigation was first made in 1936 with a view to study the pest and suggest control measures. The present paper gives a short account of the results of these investigations.

¹ Lefroy, *Memoirs Dept. Agri. Ent. Ent. Ser.*, vol. i, p. 173.

² Fletcher, *Some South Indian Insects*, p. 378.

³ Ramachandra Rao, *Madras Govt. Entomologist's Annual Report*, 1924-5.

⁴ *Ibid.*, 1928-9.

⁵ Fletcher, *Proc. 3rd Ent. Meeting*, vol. i, p. 70 (1919).

TOBACCO NURSERY AND PREPARATION AT CHIRALA.

A general account of the nature and extent of nursery cultivation at Chirala is given so that it is possible to know the environmental conditions under which the caterpillars assume pest form year after year.

Nurseries are raised over an extensive area of about 70 to 90 acres at a time, and as large an area is kept fallow for sowing in the next season. Being near the sea coast, the soil is nothing but pure sand and hence the most easily drained. Compost and redried tobacco stems are applied to the beds in fairly large quantities as manure. The beds are rectangular measuring nearly 45 ft. by 5 ft.; they are laid close together in parallel series, 12 inches apart. Preliminary cultivation is done as early as June. Sowing commences early in August and is kept going till the end of the month. *Harri-son Special* and *White Burly* are the two types of tobacco used extensively for raising the nurseries. Redried tobacco stems are strewn on the top of the beds with the double object of protecting the tender germinating seedlings from the scorching sun and preventing water scouring away the soil at the time of irrigation.

Irrigation is done by overhead splashing of water; this is done five times a day from early dawn to late in the evening. The water for irrigation is baled out by the coolies in pots from wells dug out at definite distances within the area. Seedlings are lifted for planting from about second week of October. The material is mostly taken to Guntur and other places for planting. There is very little of planting round about Chirala.

As a rule, the ryots round about follow the same method and routine in the raising of the nursery.

THE PEST, ITS INCIDENCE AND EXTENT OF DAMAGE.

From the figures kindly furnished by Mr. Winders it would appear that the insect occurs in a pest form every year and, since 1930 has been definitely known to be on the increase. Damage to seedlings in the early stages consists chiefly in the removal of mesophyll from underneath, leaving glassy translucent patches above. If the incidence starts early the seedlings are totally denuded of their first formed leaves and there is a consequential severe mortality in the seedlings. The magnitude of the problem can well be imagined when the Company spends during the critical period about Rs. 900 for spraying, and nearly an equal amount in handpicking the caterpillars.

The pest ceases to be a menace when the nursery is about a month old. It follows therefore that the pest requires to be controlled in the earlier stages, when the seedlings are in the 4th leaf stage, if really a good stand of the nursery is to be obtained.

INSECT ASSOCIATIONS.

It was often noticed that the pest occurred in association with *Plusia signata* F. and *Prodenia litura* F. in the ryots' beds and

the latter two always outnumbered the pest. But in the company's nurseries the reverse was always the case.

ALTERNATE HOST PLANTS.

Round about Chirala no other economic crop is raised in October except a few nursery beds of *Eleusine coracana*, which are found sparsely infested with *Laphygma*, but never on the scale seen in the tobacco beds. A sand dune weed *Gisekia pharnaceoides* L. was found invariably infested with the pest even as late as September; this weed was not so evident outside the Company's area, so that one is led to attribute the severity of attack in the Company's nurseries to the presence of this alternate host. There is a record made by Mr. Winders that there was a plague of these caterpillars in July 1936 in all the weeds and bungalow sites. Thus it would appear that this weed is, in all probability, the source of primary infection.

CARRY-OVER OF THE PEST DURING THE OFF-SEASON.

So far there is no evidence to show that the pest has anything like a long cycle pupal stage in the shape of hibernating or aestivating pupae. All the pupae without exception turn into adults after a specified period. There is not even a single record of a pupa surviving for over 15 days out of a rearing of nearly 200 moths in January and February. The weeds in the fallow area must be carrying on the pest till such time as the tobacco seedlings appear.

LIFE HISTORY STUDIES.

The studies detailed hereunder were made at an Insectary under Coimbatore conditions.

Moths.—They are known to lay both fertile and unfertile eggs freely during night and are less active during day time. They begin laying eggs on the 2nd day of emergence. No host preferences shown for laying eggs, a weed or stray plant is sometimes preferred to tobacco leaves.

Eggs.—Eggs are laid in small masses of 20 to 280 each; they are covered lightly with light grey felt of hairs. Each egg is pale green and highly sculptured; it changes colour from pale green to light yellow with a pink central spot at the basal end and finally becomes fuscous at the apical pole. Under captivity the eggs were freely laid on the muslin sides of the leaf and glass jars, but never on the soil. The eggs hatch in 48 to 56 hours.

Larvae.—Hatchlings are buff coloured with the head black; the abdominal segments carry black hairs mounted on warts; growth is extremely slow in the first 5 to 6 days. Full fed and half fed larvae show a wide range of variation in colour. Larvae bred out of a single pair of moths were invariably of the same colour when fed on the same food.

They bite holes into the succulent leaves from underneath. As with cutworms, they have the habit of dropping down and assuming a curved posture. They eat more voraciously at night and are not inclined to migrate far out. In an experiment, out of 45 caterpillars allowed to feed in a marked area of the tobacco nursery bed none were ever found beyond a radius of one foot even after a lapse of 10 days. Larval life lasts for about 15 days.

Pupae.—The mature larvae pupate naked mostly on the surface; a few pupate within the soil at depths of 2 to 4 inches in cocoons made of silk and earth.

Pupal period does not vary much even when the moisture content of the soil is varied. There is always a total emergence of moths and in no case was there delayed emergence. Pupal period lasts for 6 to 7 days.

Sex ratio.—The sex ratio is nearly equal. Of nearly 200 moths reared 110 were females.

Fecundity and longevity of female moths.—A female moth is ordinarily capable of laying 1,310 eggs. The daily output for the first few days ranges near 350 to 300 eggs. There is then a gradual fall. The moths are capable of living for 15 days when fed on sugar syrup.

Life cycle.—A generation is completed in about 24 days.

PARASITES AND PREDATORS.

Numerous caterpillars were collected separately from the tobacco seedlings and the weed, and kept separate in small receptacles. From the former there were no parasites. But from the latter two tachinid parasites—*Sturmia inconspicuoides* and *Actia monticola*—were obtained. Only five larvae were found parasitized out of a total of 150.

It seems strange that out of a large number of caterpillars collected from tobacco there should be no parasites. The repeated waterings and extra dense vegetation, perhaps, offer little scope for the parasite to play its role effectively and hence their total absence. A Reduviid bug—*Rhinocoris fuscipes*—was found in fairly large numbers. These natural enemies were studied and the following is a summary of the same.

Rhinocoris fuscipes.—This is predaceous on young and old caterpillars. An adult bug can easily finish off four to five caterpillars in a day. As a rule, bugs are less inclined to attack full grown caterpillars, unless forced to for want of suitable stages. In captivity, they take to full grown caterpillars of every kind. Two or three of them sometimes join together and suck the larva dry; it is reduced to an empty skin before it is finally discarded. The following caterpillars and grubs were tried and found acceptable to the bug:—(1) *Spodoptera mauritia* B, (2) *Prodenia litura* F, (3) *Anaphaeis messentina*, (4) *Noorda blitealis* W, and (5) *Hypolixus brachyrrhinus* B.

Adults and nymphs seem to thrive extraordinarily well on *Pereginus maidis*, the cholam shoot bug, on which most of the

rearing was done at the Insectary. There was no paucity for the shoot bug so long as there was cholam crop in the field.

Sexes can easily be distinguished. The female is usually more plump and is devoid of any mid-vertical black stripe on the last abdominal segment. The latter character is possessed by the male and serves to distinguish it from the female.

Pre-oviposition period.—This period lasts for about 2-3 days. The female pairs with the male easily and remains in copula for nearly half an hour. Eggs are usually laid in the night on the 5th day of emergence.

Eggs.—Eggs oblong and finger shaped, arranged vertically in batches of 5 to 38. They are olive in colour when fresh but later turn dark chestnut brown. The apical end is provided with a white frill like top which is drawn out into a papery rim. There is a tessellated depressed area in the centre. The outside surface of the egg is finely rugose. Each egg measures 5 mm. long and 2 mm. broad at the top. The eggs hatch normally in 5 to 7 days. Emergence is always total and takes place both in the mornings and afternoons.

Nymphs.—From casual inspection, the first instar nymphs look like small red ants—*Monomorium*. They are orange in colour; on the apical end of the abdomen is a black patch which is very conspicuous. The nymphs have the habit of tilting up the abdomen while moving about. But this habit is lost when food is taken and the abdomen is gorged. For want of young caterpillars, *Aphis gossyphii* G. and *Macrosiphum pisi* were offered but were not accepted. Both adults and nymphs however, feed well on *Peregrinus maidis*. Each nymph is capable of destroying 4 to 8 shoot bugs quite easily. The prey is held up at the point of the proboscis and is dropped only after completely sucked. Slightly advanced nymphs also feed on *Tribolium* and *Myloccerus* beetles. The well-fed nymph has a bloated abdomen and the black patch is rendered very conspicuous.

The nymphs undergo 5 moults before becoming adult. The interval between an instar is roughly 4 to 5 days. In the last instar the nymph is fairly well developed and assumes a ruddy hue in sharp contrast with the dull orange colour of the previous instars. The adult transformation is effected by the nymph of the sixth instar breaking open along the fronto-thoracic region and slowly pushing its head and body out. At the time of transformation, the head and the body are pink and after hardening, develop the bright crimson and shining black colour of the adults.

Fecundity of female bugs.—Each female is capable of laying a maximum of 340 eggs. The daily range of egg-laying varies from 5 to 38. Eggs are laid sometimes on alternate days and sometimes in regular sequence.

Longevity.—Adults, both male and female, are capable of living up to 35 to 90 days.

Total life cycle.—The life cycle is completed in 31 to 51 days.

The following tables give further details regarding life cycle.

LIFE CYCLE RECORD

Serial No.	When eggs were laid	When hatched	Egg period in days	First moult	Second moult	Third moult	Fourth moult	Fifth moult	When adults emerged	Nymphal period in days	Total life cycle in days
1	15-10-36	21-10-36	6						6-12-36	45	51
2	15- 2-37	23- 2-37	8						27- 3-37	34	42
3	15- 2-37	22- 2-37	7	1-3-37	5-3-37	8-3-37	16-3-37	23-3-37	27- 3-37	26	33
4	17- 2-37	24- 2-37	7	3-3-37	5-3-37	8-3-37	13-3-37	20-3-37	24- 3-37	30	33
5	18- 2-37	23- 2-37	5						23- 3-37	30	35
6	19- 2-37	26- 2-37	7	5-3-37	8-3-37	13-3-37	20-3-37	26-3-37	31- 3-37	35	42
7	22- 2-37	1- 3-37	7						31- 3-37	31	38
8	24- 2-37	3- 3-37	7	7-3-37	11-3-37	16-3-37	20-3-37	27-3-37	1- 4-37	30	37
9	28- 2-37	6- 3-37	6						1- 4-37	25	31
10	2- 3-37	9- 3-37	7						4- 4-37	27	34
11	3- 3-37	10- 3-37	7						5- 4-37	25	32
12	27- 2-37	6- 3-37	7	13-3-37	16-3-37	18-3-37	21-3-37	27-3-37	1- 4-37	25	32
13	6- 3-37	13- 3-37	7	18-3-37	24-3-37	30-3-37	5-4-37	9-4-37	12- 4-37	30	37

FECUNDITY RECORD.

Adult No. 1		Adult No. 2		Adult No. 3		Adult No. 4	
Date	Eggs laid	Date	Eggs laid	Date	Eggs laid	Date	Eggs laid
21-12-36	4	15-2-37	21	18-2-37	37	7-4-37	21
23-12-36	22	17-2-37	15	22-2-37	34	8-4-37	11
25-12-36	26	18-2-37	24	25-2-37	16	9-4-37	22
31-12-36	68	19-2-37	24	26-2-37	20	10-4-37	11
1- 1-37		21-2-37	21	28-2-37	26	11-4-37	10
2- 1-37	36	24-2-37	30	3-3-37	29	12-4-37	18
4- 1-37		26-2-37	21	6-3-37	32	13-4-37	—
9- 1-37	23	28-2-37	23	9-3-37	26	14-4-37	19
17- 1-37	13	1-3-37	8	10-3-37	12	15-4-37	10
Female died on 27-1-37		2-3-37	9	11-3-37	13	16-4-37	28
		4-3-37	38	Female died on 13 3-37		17-4-37	—
		6-3-37	21			18-4-37	24
		8-3-37	23			19-4-37	—
		12-3-37	5			20-4-37	—
		15-3-37	21			21-4-37	24
		17-3-37	18			26-4-37	Female escaped
		20-3-37	13				
		21-3-37	5				
		Female died on 26-3-37					
Total ...	192	Total ...	340			Total ...	246

Tachinid.—The habits of *Sturmia inconspicuoides* were studied somewhat in detail.

The female is smaller than the male. Immediately after emergence the pair go in copula and remain so for a period extending for more than an hour. The fly freely lays eggs thereafter on any caterpillar given to it during day time. When given a caterpillar the fly approaches it but stands aloof at some distance. When the caterpillar rears its head the fly projects her ovipositor from underneath and glues an egg on to it. Or, an egg is glued on the head without any movement from the caterpillar. All this is done in a twinkling. The egg is pale white but later on turns creamy in colour. As a rule, only one egg is laid and that on or near the head. In rearing studies, every caterpillar which received an egg died the next day before the maggot could get a start and hence rearing could not be pursued further. Six caterpillars were given in succession and every one of them received an egg on the head, all in an hour.

Trichogramma minutum.—Though no actual parasitization of eggs was observed in the field *Laphygma* egg masses were given to the parasite to parasitize them. There were six trails

under enclosed conditions. The results obtained are tabulated hereunder.

PARASITIZATION RECORD—HOST: LAPHYGMA EGGS.

No.	When parasites introduced	When parasites emerged	No. of eggs in egg mass	No. eggs parasitized	No. of hatchlings found	No. of eggs spoiled
1	13-1-37	22-1-37	142	40	42	58
2	15-1-37	25-1-37	126	40	44	42
3	23-1-37	3-2-37	86	32	24	30
4	24-1-37	4-2-37	78	21	14	41
5	28-1-37	7-2-37	148	36	42	57
6	31-1-37	10-2-37	196	37	81	68

The parasites would appear to regard the felt of hairs as an impediment to a complete parasitization. Eggs on the margins are more easily parasitized than those in the centre.

The utilisation of the parasites and predators in the control of the pest looks far from promising. Firstly, the reproductive potential of the pest is very high when compared with that of the predatory bug or of the parasites in a given length of time; secondly, as the life cycle of the bug is extended over a longer period it cannot be expected to complete sufficient generations to outstrip the pest in numbers; thirdly, the duration of the crop is short. Hence the idea of biological control has to be given up.

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